The "Greatest" Carry Trade Ever? Understanding Eurozone Bank Risks

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Motivation

- Sovereign debt crisis has cast doubt on the solvency of European banks due to massive impairments and mark-to-market losses on sovereign bond holdings
  - Greece, Ireland, Portugal, Spain and Italy (GIPSI)

- Widening bond yield spreads between GIPSI countries and, for example, German bunds

Figure 1.A. Pairwise Comparison of Government Bond Yield Spreads: Italy versus Germany

This graphic shows the time series of 10-year government bond yields comparing Italian and German 10-year government bond yields since January 2005 (Source: Bloomberg).
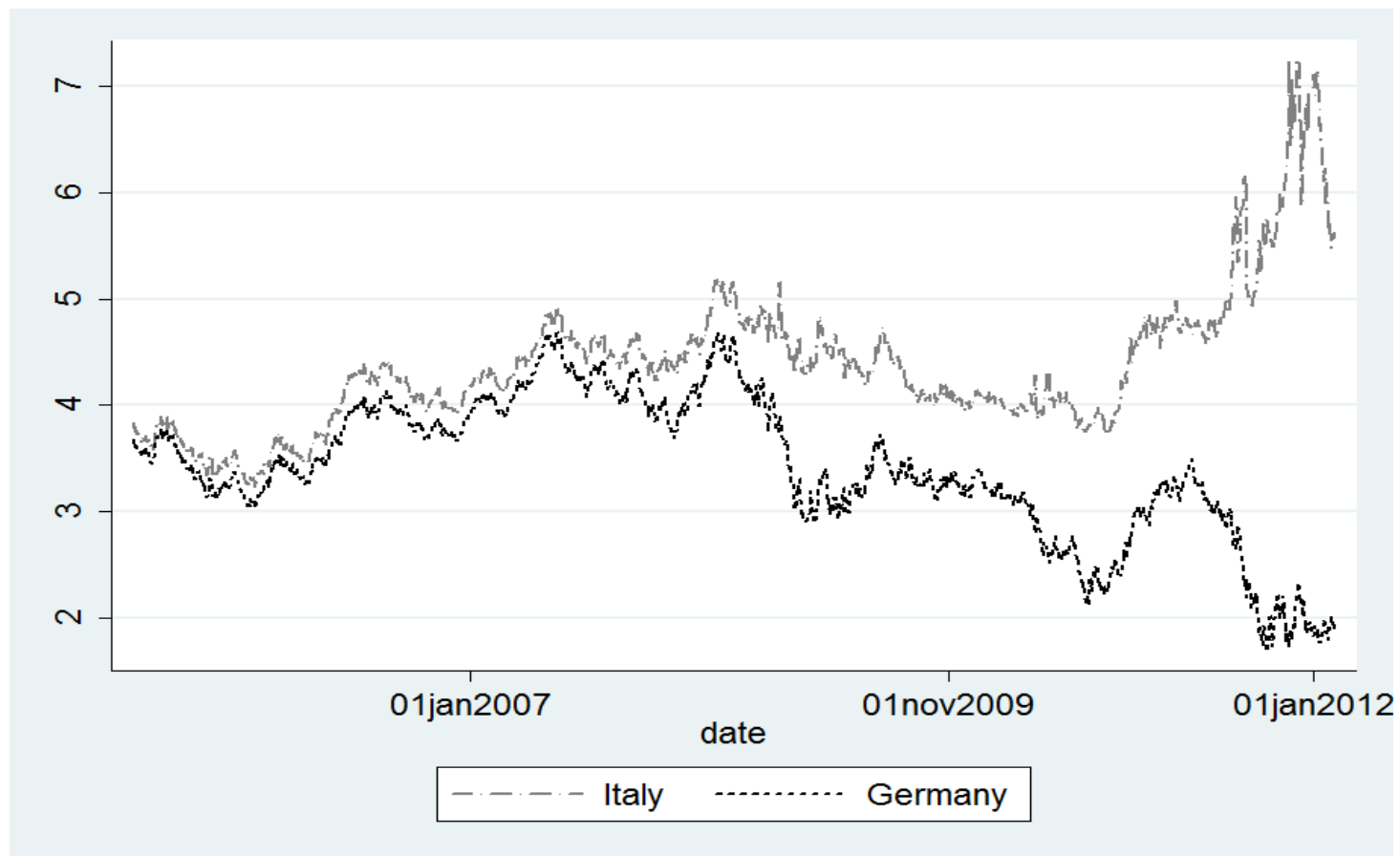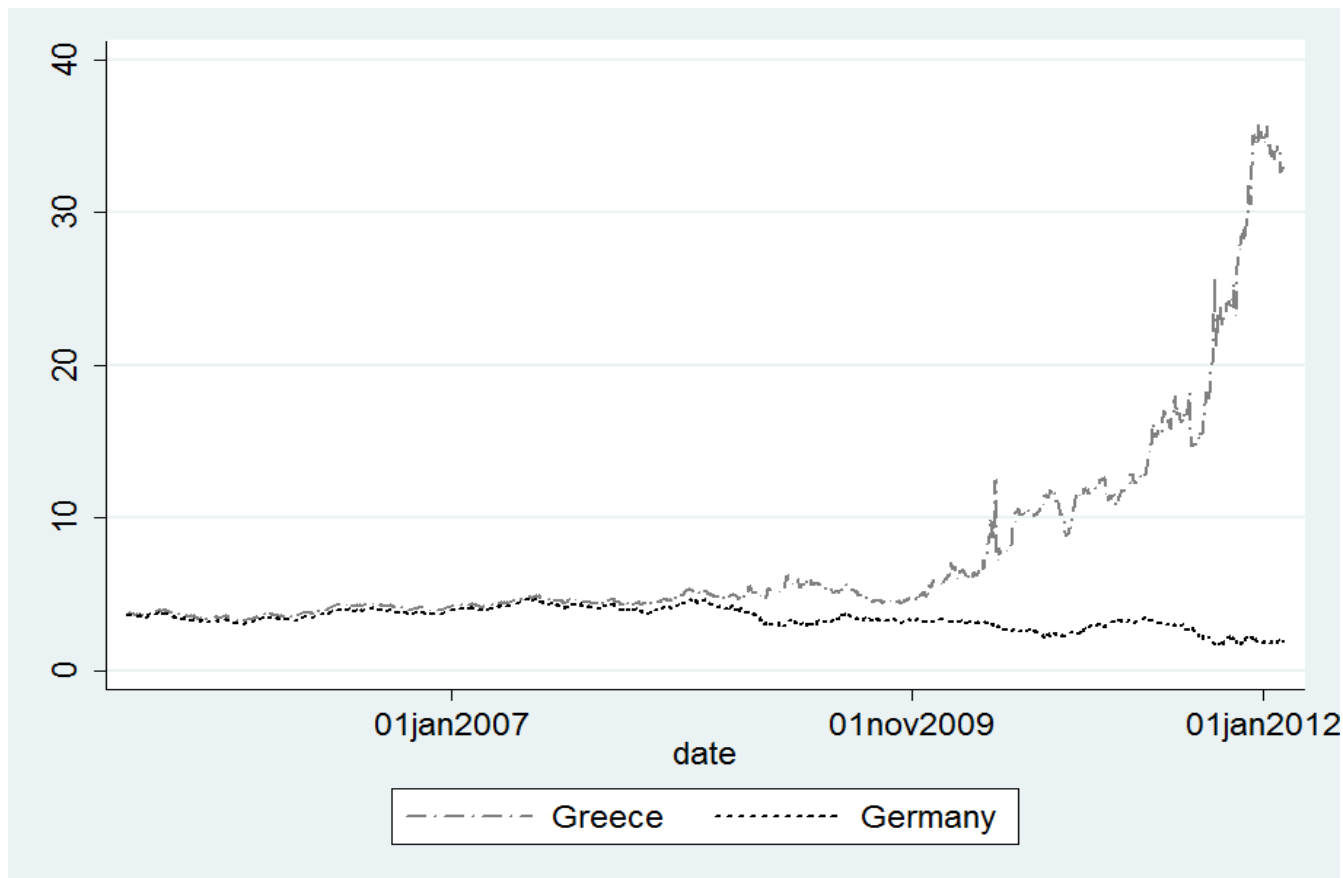
Figure 1.B. Pairwise Comparison of Government Bond Yield Spreads: Greece versus Germany

This graphic shows the time series of 10-year government bond yields comparing Greek and German 10-year government bond yields since January 2005 (Source: Bloomberg).

Motivation

- Sovereign debt crisis has cast doubt on the solvency of European banks due to massive impairments and mark-to-market losses on sovereign bond holdings
    - Greece, Ireland, Portugal, Spain and Italy (GIPSI)

- Widening bond yield spreads between GIPSI countries and, for example, German bunds

- Banks have lost about 70% of market value since 2010 and shed billions of Euros of assets

- Sovereign debt crisis has even challenged the survival of the Eurozone

"Carry Trades" in Peripheral Sovereign Bonds

- (Our results suggest that) Bank risk in this period can be understood as reflecting a "carry trade" behavior
  - Financing leg: short-term wholesale market
  - Investment leg: long-term GIPSI government bonds

- Carry trade reflects a bet on the economic convergence of the Eurozone and a convergence of the spread between the two legs

- Banks gain on the upside when yields of GIPSI countries decrease (and market prices increase), i.e. banks can pocket the "carry"
- Bank lose on the downside when spreads between both legs diverge further
  - Leading to losses of banks on sovereign bond portfolio
  - Questioning solvency and/or liquidity of banks in funding markets
- Current regulatory capital requirement in fact incentivizes such behavior by treating most sovereign bonds as safe and ignoring short-term funding

Dexia S.A. – A Carry Trade Gone Bad

"And of course, the deterioration of the Euro zone situation and particularly the sovereign crisis in the peripheral economies hit very badly the group. And that's of course not a surprise for a group that still had very important short-term funding needs that was mainly present in strong exposures in peripheral countries. [...] Before 2008, it was the group's high rating granting easy access to wholesale funding that led to the situation of October 2008 with short-term funding need of €260 billion outstanding in October 2008, i.e. 43% of total balance sheet. [...] with very significant acceleration and buildup of the bond portfolio was amounting at €203 billion at the end of 2008. Mostly carry-trades with marginal improvement of customer access [...] that led to a very significant gearing ratio because the portfolio size was, at that time, 25 times the group equity."

(Pierre Mariani, Chairman-Management Board & CEO, Dexia SA, Earnings Call, February 23rd, 2012)

The "Greatest" Carry Trade Ever?

Dexia S.A. – A Period of Leverage and Growth

- Most of Dexia's profitability until summer 2008 was coming from maturity transformation and non-core investment activities.
  - As of October 2008, Dexia was funded with EUR 260 billion short term (mostly unsecured) debt (40% of its balance sheet) and had EUR 203 billion bond portfolio
  - About EUR 22 billion GIPSI bonds
  - Average maturity of assets > 11yrs, funded in inter-bank and money markets
  - October 3rd, 2008: 1st bailout and recapitalization by governments

- Dexia's liquidity under pressure since March 2011, when both Moody's and S&P placed Dexia's ratings under review for possible downgrade
  - Dexia lost about EUR 80 billion short-term funding and deposits between March and October 2011
  - Plus had to post about EUR 15 billion in cash collateral as margin for hedges -> Dexia was long fixed interest rates hedged with interest rate swaps
    - Total return swap position that was short the German bunds

Figure 2.C. Dexia Stock Price Decline since Janurary 2011

This graphic shows Dexia's stock price performance since January 2011.

Dexia S.A. Stock Price since January 2010
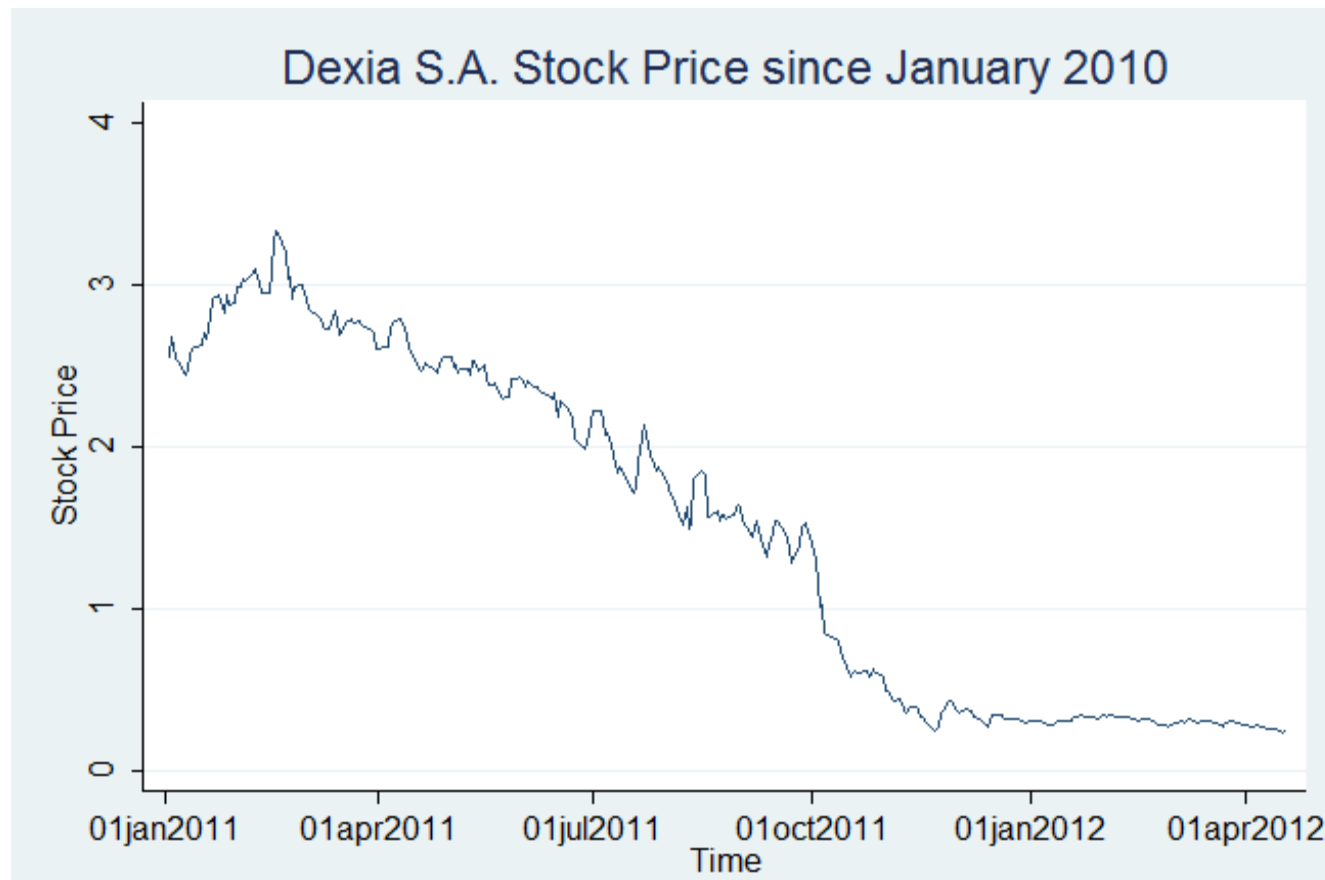
In this Paper

- We show that Dexia-style behavior was pervasive among European banks
    - Long peripheral sovereign bonds financed in short-term wholesale markets

- We analyze various motives for banks to participate in carry trades
    - Implicit bailout guarantees, risk-shifting by under-capitalized banks, regulatory capital arbitrage, cheap central-bank financing

- We discuss alternative hypothesis
    - Home bias, cross-border exposure to real sector of periphery, (im-) moral suasion and redenomination

- We analyze whether banks' carry trade behavior is predictive of future capital raisings and ECB dependence

- We analyze the time-series of carry trade exposures and whether government bond purchases crowd out real sector lending

Data

- We collect market information from Bloomberg
  - Stock prices, 10-year sovereign bond yields, bank and sovereign CDS spreads

- The European Banking Authority (EBA) disclosed information about banks' bond portfolio after the 3 stress tests
  - July 2010, July 2011 and December 2011 (capital exercise)
  - Information about banks' Tier 1 ratios in "stressed scenarios"

- Financial information of banks from SNL Financial

- Annual and quarterly reports from banks
  - ECB funding, repo transactions

- S&P Credit Portal, European Central Bank (ECB) and Bank for International Settlement (BIS)
  - Credit reports, (aggregate) lending information

Sample of Banks

Bank	SNL ID	Ticker	Ticker-Exchange	Country	Total Assets (EUR 000) (30.6.2011)
Deutsche Bank AG	113830	DBK	DBK-ETR	Germany	2,164,103,000
HSBC Holdings Plc	113876	HSBA	HSBA-LON	United Kingdom	1,967,795,830
BNP Paribas SA	3001689	BNP	BNP-PAR	France	1,965,283,000
Barclays Plc	114508	BARC	BARC-LON	United Kingdom	1,871,468,662
Royal Bank of Scotland Plc	3001937	RBS	RBS-LON	United Kingdom	1,803,649,293
Crédit Agricole SA	4085960	ACA	ACA-PAR	France	1,723,608,000
Banco Santander SA	113983	SAN	SAN-MAD	Spain	1,251,524,817
ING Groep N.V.	113837	INGA	INGA-AMS	Netherlands	1,242,739,000
Société Générale SA	113818	GLE	GLE-PAR	France	1,181,372,000
Lloyds Banking Group Plc	4041848	LLOY	LLOY-LON	United Kingdom	1,161,698,150

- We start with all publicly listed banks that participated in the EBA stress tests
  - Exclude some due to data availability (e.g. HRE, Bankia, Irish Life and Permanent)

- Overall, 51 banks included in our analysis (top 10 shown above)

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Table II. Descriptive Statistics on Return Correlations

Panel B. Soverein bond return correlations (2005)

	Greece	Italy	Portugal	Spain	Ireland	Germany	France	UK
Greece	1.00							
Italy	0.97	1.00						
Portugal	0.65	0.67	1.00					
Spain	0.96	0.98	0.65	1.00				
Ireland	0.92	0.93	0.64	0.93	1.00			
Germany	0.96	0.98	0.66	0.98	0.94	1.00		
France	0.96	0.98	0.66	0.98	0.94	0.98	1.00	

Panel C. Soverein bond return correlations (2011/2012)

	Greece	Italy	Portugal	Spain	Ireland	Germany	France	UK
Greece	1.00							
Italy	0.12	1.00						
Portugal	0.19	0.22	1.00					
Spain	0.13	0.77	0.17	1.00				
Ireland	0.26	0.17	0.33	0.23	1.00			
Germany	-0.13	-0.27	-0.10	-0.19	-0.17	1.00		
France	-0.02	0.22	0.00	0.23	-0.03	0.51	1.00	

Table III. Descriptive Statistics on Bank Characteristics

	Obs	Mean	Std-Dev	Min	P50	Max
Log-Assets	51	11.88	1.65	7.82	11.99	14.38
ST-LVG	43	0.33	0.14	0.00	0.31	0.71
RWA / Assets	50	0.52	0.17	0.18	0.55	0.84
Book-LVG	51	21.61	10.09	2.02	18.68	59.22
Tier-1 Ratio	50	9.30	1.65	6.66	9.05	13.97
"Stressed" Tier 1 Ratios						
$Tier1_{07/2010}$	49	0.10	0.02	0.07	0.10	0.17
$Tier1_{07/2011}$	50	0.08	0.03	-0.01	0.08	0.14
$Tier1_{12/2011}$	41	0.10	0.03	0.06	0.09	0.20
Capital Issuance Actvity & ECB Funding						
Jan 2007 - Feb 2012						
Capital (Yes/No)	51	0.86	0.35	0.00	1.00	1.00
Log-Capital	44	14.18	1.64	7.77	14.39	16.81
ECB / Assets	32	0.07	0.07	0.00	0.05	0.22

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Table III. Descriptive Statistics on Bank Characteristics (cont'd)

Panel C: Factor loadings

	Obs	Mean	Std-Dev	Min	P50	Max
Factor loadings						
β_{Italy}	833	1.84	2.00	-3.17	1.40	16.42
β_{Spain}	833	1.42	2.13	-9.45	0.95	18.64
β_{Greece}	833	0.98	1.60	-1.89	0.36	15.36
$\beta_{Germany}$	833	-2.76	2.13	-20.81	-2.44	5.97
No GIPSI banks						
β_{Italy}	765	1.85	2.05	-3.17	1.39	16.42
β_{Spain}	731	1.47	2.24	-9.45	0.97	18.64
β_{Greece}	731	0.94	1.64	-1.89	0.32	15.36
GIPSI banks						
β_{Italy}	68	1.75	1.14	-0.11	1.52	4.98
β_{Spain}	102	1.02	0.84	-0.90	0.81	3.56
β_{Greece}	102	1.25	1.32	-0.43	0.81	5.61

Table III. Descriptive Statistics on Bank Characteristics (cont'd)

Panel D. Sovereign bond holdings

	Greece	Italy	Portugal	Spain	Ireland
March 2010	94,912	264,500	27,154	174,833	24,878
December 2010	85,558	303,999	30,799	200,283	18,221
September 2011	24,579	267,218	28,723	177,466	17,016
December 2011	19,939	223,208	22,267	137,874	16,327
June 2012	1,818	258,894	25,600	148,422	17,494

	Greece	Italy	Portugal	Spain	Ireland
No GIPSI banks					
March 2010	34,814	115,472	14,776	29,190	18,677
December 2010	28,208	132,803	14,636	41,923	5,017
September 2011	21,832	103,137	13,975	30,039	3,845
December 2011	17,355	69,243	10,390	22,311	3,528
June 2012	1,672	69,344	10,169	20,615	2,961
GIPSI banks					
March 2010	56,148	144,856	5,176	143,869	5,322
December 2010	54,447	164,011	10,351	154,793	12,466
September 2011[1]	NA	156,043	10,972	143,629	12,455
December 2011[1]	NA	147,746	8,180	111,774	12,109
June 2012[1]	NA	184,171	10,657	124,385	13,848

The "Greatest" Carry Trade Ever?

Methodology

- Our approach is to measure the sensitivity of banks' stock returns to changes in sovereign bond prices

$$Stock\ Return_{i,t} = \alpha_{i,t} + \beta_{GIPSI}GIPSI_t + \beta_{Germany}Germany_t + \gamma Index_{j,t} + \varepsilon_{i,t}$$

- $GIPSI$ is Greece, Italy, Portugal, Spain or Ireland

- β_{GIPSI} and $\beta_{Germany}$ are the factor loadings and measure of exposure to sovereign debt and short-term funding

- $Index_{j,t}$ is the residual from regressing stock index return on domestic sovereign j return and German bund return

- Standard errors clustered in two dimensions: bank and quarter

Table IV. Stock and Bond Return Correlations

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent Variable: Stock Return			
Greece	0.095***					0.048***
	(5.73)					(2.73)
Italy		0.432***				0.261***
		(5.12)				(2.93)
Spain			0.427***			0.077
			(8.78)			(1.46)
Portugal				0.130***		0.007
				(3.05)		(0.57)
Ireland					0.267***	0.132**
					(5.32)	(2.49)
Germany	-2.460***	-2.563***	-2.611***	-2.500***	-2.517***	-2.558***
	(-19.09)	(-23.64)	(-23.07)	(-19.40)	(-19.78)	(-22.70)
Index	1.359***	1.363***	1.367***	1.373***	1.371***	1.354***
	(14.98)	(15.17)	(15.27)	(15.02)	(15.30)	(15.25)
Constant	-0.001**	-0.001***	-0.001***	-0.001***	-0.001**	-0.001***
	(-2.56)	(-2.94)	(-2.64)	(-2.75)	(-2.58)	(-2.73)
Observations	55,206	55,206	55,206	55,206	55,206	55,206
R-squared	0.46	0.46	0.46	0.46	0.46	0.46

Carry Trade Behavior of European Banks

- Positive correlation of GIPSI bond returns and stock returns suggest that banks are long GIPSI government debt
  - Particularly Greece and Italy

- Negative factor loading on German government bonds suggest banks are effectively „short" German government bonds

- Consistent with carry trade behavior of European banks
  - They appear to have invested in long-term peripheral bonds
  - Financed in short-term wholesale markets to maximize the carry

- Negative factor loading on German bunds reflect „flight to quality"
  - Upon adverse economic or financial news, investors „fly" into long-term German bunds, reducing their supply of short-term funding for banks
  - If banks are exposed to short-term funding, it appears as if banks were short long-term German bunds

Table IV. Stock and Bond Return Correlations (cont'd)

	(1) Home	(2) Macro	(3) PCA	(4) Funding Leg	(5) Maturity	(6) Δ Log(Bank CDS)	(7)
Greece	0.008	0.052***		0.073***	0.014***	-0.150***	
	(0.49)	(3.07)		(4.50)	(3.82)	(-4.77)	
Italy	0.217**	0.256***		0.735***	0.014	-0.161	
	(2.39)	(2.84)		(6.68)	(0.29)	(-0.93)	
Spain	0.029	0.095*		-0.009	-0.043	-0.270*	
	(0.55)	(1.80)		(-0.06)	(-0.46)	(-1.67)	
Portugal	-0.005	0.007		-0.007	0.006	-0.117*	
	(-0.46)	(0.62)		(-0.13)	(0.41)	(-1.94)	
Ireland	0.119**	0.135**		0.143**	0.046**	-0.203*	
	(2.42)	(2.57)		(1.99)	(2.49)	(-1.90)	
Germany	-2.662***	-2.717***	-2.570***		-1.819***	2.913***	2.983***
	(-23.74)	(-21.47)	(-21.77)		(-12.97)	(6.39)	(6.15)
Index	1.365***	1.419***	1.357***	1.355***	1.270***	-0.745***	-0.755***
	(14.94)	(16.29)	(15.29)	(15.22)	(19.61)	(-7.61)	(-7.62)
Home	0.295***						
	(8.34)						
ΔVSTOXX		0.088***					
		(3.91)					
ΔEuropean Econ,.Sent.		0.037**					
		(2.38)					
ΔLevel of Ind. Prod.		0.044*					
		(1.84)					
PC1			0.002***				-0.004***
			(8.60)				(-4.70)
France				-2.294***			
				(-8.21)			
Observations	55,206	55,005	55,206	55,206	55,086	29,832	29,832
R-squared	0.47	0.46	0.46	0.42	0.43	0.13	0.13

- Other variables included in (2): Term Structure, Bond Default Spread, 1m Euribor, ΔEuropean Consumer Price Index

Tests Supporting the Notion of "Carry Trade" Behavior

- Home bias in domestic sovereign bonds
    - Include home country bond return in analysis

- Principal component analysis (PCA)
    - Use linearly independent eigenvector which is a linear combination of GIPSI bond returns that explains largest part of variation in GIPSI bond returns.
    - This „index" is used instead of GIPSI bond returns in regressions.
    - Results are unchanged

- Funding leg
    - We use French government bond returns as funding leg.
    - We find similar (albeit weaker) results
    - See the divergence between French and German goverment bond returns since EOY 2011...

Tests Supporting the Notion of "Carry Trade" Behavior (cont'd)

- Maturity
  - Carry trades are most profitable if investments are as long-dated and funding as short-term as possible
  - Use 2-year GIPSI government bonds returns instead of 10-year
  - GIPSI coefficient reduced by factor 6

- Bank CDS spreads
  - CDS spreads important proxy for bank risk and funding costs
  - CDS spreads should reflect a widening of the gap between GIPSI and German government bonds
  - We find that if Greek bond prices fall, CDS spreads appreciate consistent with higher solvency risk of banks
  - Using PCA shows similar results

Alternative Explanations

- Our hypothesis: Factor loadings reflect moral hazard behavior of banks

- Factor loadings do not reflect actual portfolio holdings of banks but other underlying economic linkages

- Factor loadings reflect cross-border exposures of large internationally active banks

- Factor loadings reflect home bias of, e.g. Italian banks holding Italian sovereign debt

- Peripheral banks have other incentives to hold sovereign debt
  - Government asks them to buy sovereign debt ((im-) moral suasion)
  - Peripheral banks have an advantage to hold debt of their own country in the case of a break-up of the Eurozone (redenomination hypothesis)

Factor Loadings and Bank's Direct Exposure

- Do these exposures relate to actual government bond holdings of banks or simply reflect some other underlying economic exposures and linkages?

- We use disclosures of sovereign bond holdings after each of the EBA stress tests

- We estimate the factor loadings in the time period 60 days before and after reporting dates associated with each stress test.

- Figure 3 plots β_{Italy}, β_{Spain} and β_{Greece} against sovereign bond holdings over total assets at three disclosure dates: September 2011, December 2011 and June 2012.

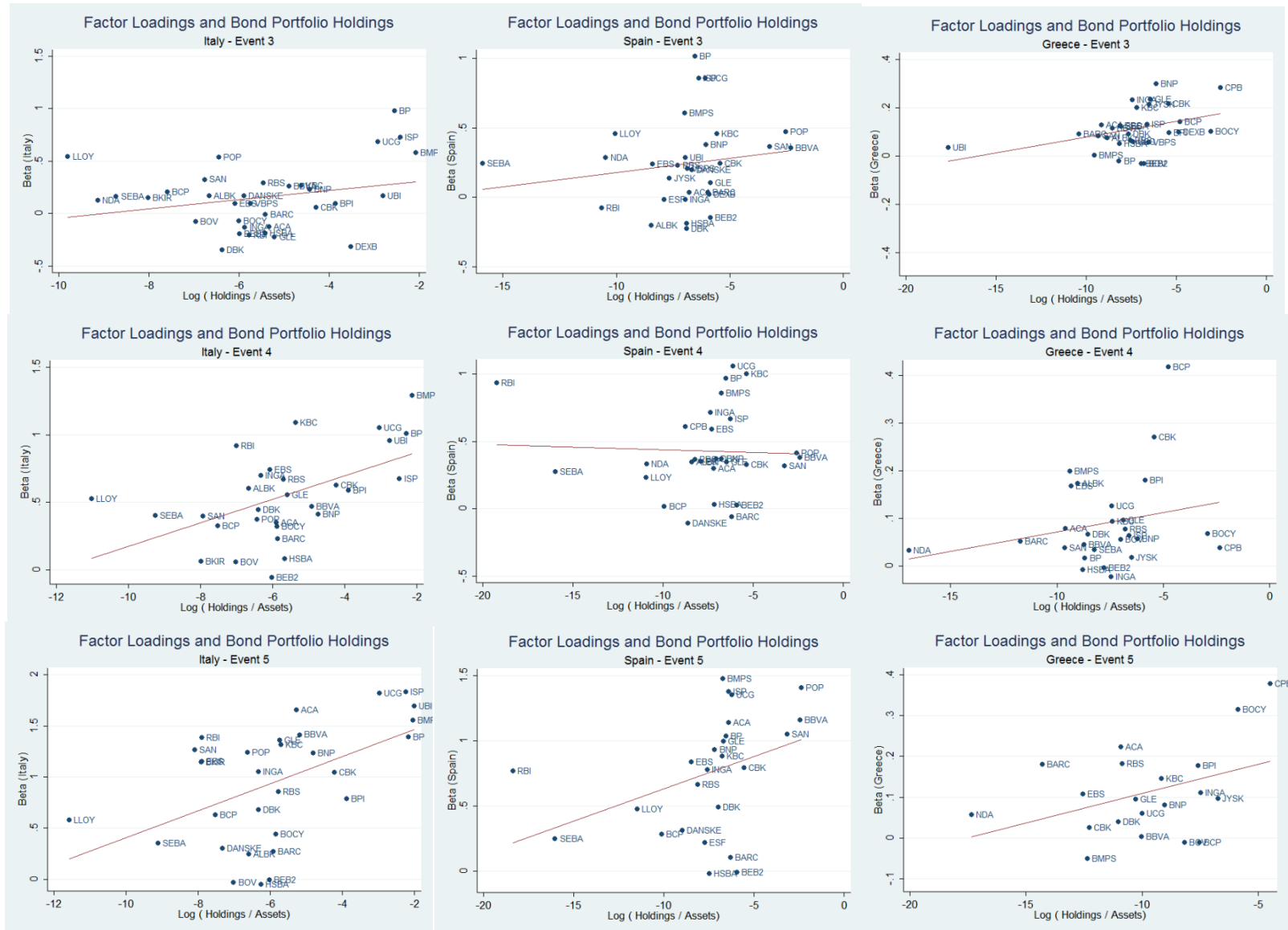# Figure 3. Factor Loadings and Bank Portfolio Holdings

Table IV. Bond Holdings and Factor Loadings

	β_{Italy}				β_{Spain}				β_{Greece}			
	Full (1)	Non-Italian (2)	Non-Italian (3)	Non-Italian (4)	Full (5)	Non-Spanish (6)	Non-Spanish (7)	Non-Spanish (8)	Full (9)	Non-Greek (10)	Non-Greek (11)	Non-Greek (12)
Italy-Sov / Assets	6.881***	20.769**	17.732***	37.858***								
	(5.97)	(2.20)	(3.15)	(2.79)								
Spain-Sov / Assets					5.763***	68.506**	73.182***	112.711***				
					(3.12)	(2.06)	(2.85)	(3.12)				
Greece-Sov / Assets									2.006***	2.701*	2.588**	-0.693
									(4.15)	(1.88)	(2.21)	(-1.64)
December 2010			-0.817***	-1.074***			-0.711***	-0.928***			0.103**	0.039
			(-4.72)	(-8.22)			(-5.28)	(-9.81)			(2.58)	(0.91)
September 2011			-1.253***	-1.819***			-0.952***	-1.461***			-0.016	-0.043**
			(-7.97)	(-9.78)			(-7.65)	(-12.64)			(-0.82)	(-2.41)
December 2011			-0.871***	-1.356***			-0.753***	-0.997***			-0.043*	-0.077***
			(-5.46)	(-7.73)			(-5.86)	(-8.82)			(-1.95)	(-3.60)
June 2012			-0.641***	-1.087***			-0.561***	-0.841***			-0.019	-0.065***
			(-3.66)	(-6.84)			(-4.09)	(-7.72)			(-0.89)	(-2.95)
Constant	0.535***	0.483***	1.249***	1.746***	0.485***	0.425***	1.057***	1.431***	0.121***	0.114***	0.108***	0.194***
	(11.11)	(8.83)	(7.81)	(11.81)	(12.61)	(9.19)	(8.77)	(14.10)	(11.34)	(10.86)	(6.51)	(11.45)
Bank FE	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
Observations	205	180	180	181	205	184	184	185	211	199	199	200
R-squared	0.10	0.04	0.40	0.62	0.05	0.03	0.35	0.70	0.26	0.06	0.18	0.12

- Estimated factor loadings are positively correlated with actual holdings around the EBA stress tests (cross-section and within-bank).

Table V. Non-Sovereign Cross-Border Exposure of Banks

	β_{Italy}				β_{Spain}				β_{Greece}			
	Full (1)	Full (2)	Full (3)	Non-Italian (4)	Full (5)	Full (6)	Full (7)	Non-Spanish (8)	Full (9)	Full (10)	Full (11)	Non-Greek (12)
Italy- Real / Assets	1.148*** (4.09)		-0.602 (-0.63)	4.990 (0.73)								
Italy-Sov / Assets		8.565*** (2.95)	12.091 (1.52)	36.248*** (2.81)								
Spain- Real / Assets					0.657** (2.66)		-0.808 (-1.41)	-3.556 (-0.81)				
Spain- Sov / Assets						6.847*** (3.53)	13.158*** (3.37)	71.094 (1.39)				
Greece-Real / Assets									1.527*** (9.66)		1.305*** (4.55)	6.846** (2.40)
Greece-Sov / Assets										3.095*** (5.78)	0.578 (1.11)	-17.989 (-1.67)
Constant	0.845*** (6.84)	0.807*** (6.38)	0.799*** (6.20)	0.685*** (5.14)	0.691*** (9.53)	0.676*** (9.36)	0.676*** (9.32)	0.625*** (6.56)	0.209*** (5.69)	0.227*** (6.14)	0.209*** (5.62)	0.219*** (5.54)
Observations	51	51	51	46	51	51	51	45	51	51	51	45
R-squared	0.06	0.08	0.09	0.08	0.07	0.11	0.12	0.05	0.49	0.40	0.49	0.20

- Bank sovereign and real sector exposure from Dec 2010 (reporting date).
- Real sector exposure includes corporate, retail and commercial real estate.

Bank Risk and Leverage

- One motive for banks to participate in carry trades is to exploit an implicit bailout guarantee from their domestic sovereign
  - Log(Assets): Large banks have higher likelihood to be bailed out

- We use a direct measure of short-term leverage (ST-LVG).
  - Banks financed with more short-term leverage should benefit more from carry trades, i.e. they can pocket the largest carry

- As proxy for bank risk on the asset side of the balance, we use the size of the loan portfolio divided by total assets (Loans / Assets)

- All risk proxies are lagged by 1 year

Table VI. Risk and Leverage

	Full (1)	Italy Non-GIPSI (2)	GIPSI (3)	Full (4)	Spain Non-GIPSI (5)	GIPSI (6)	Full (7)	Greece Non-GIPSI (8)	GIPSI (9)
GIPSI$_t$	-1.567***	-1.378***	-0.028	-1.364***	-1.173***	-4.201***	-0.18	-0.359***	-2.214
	(-3.80)	(-2.87)	(-0.04)	(-3.72)	(-3.32)	(-7.10)	(-1.09)	(-3.26)	(-1.92)
GIPSI x Log-Assets$_{t-1}$	0.083***	0.066**	0.132**	0.076***	0.069***	0.205***	0.008	0.021***	0.181
	-3.43	-2.5	-2.86	-3.81	-3.38	-6.8	-1.02	-4.12	-2.05
GIPSI x ST-LVG$_{t-1}$	0.828**	0.922**	-1.595**	0.610*	0.374	0.298	0.182	0.309***	-0.567
	-2.31	-2.31	(-3.29)	-1.81	-1.13	-0.59	-1.24	-4.08	(-1.77)
GIPSI x Loans / Assets$_{t-1}$	1.229***	1.172***	-0.615	1.152***	1.114***	3.028**	0.192*	0.112	0.991*
	-6.01	-4.19	(-1.44)	-5.66	-5.36	-4.06	-1.78	-1.47	-2.48
Germany$_t$	-0.734	-0.423	3.396	-0.676	-0.727	8.564**	-1.149	-0.91	4.951***
	(-0.47)	(-0.25)	-1.17	(-0.43)	(-0.45)	-3.6	(-0.75)	(-0.55)	-7.2
Germany x Log-Assets$_{t-1}$	-0.091	-0.102	-0.454*	-0.096	-0.087	-0.562***	-0.08	-0.094	-0.735***
	(-1.21)	(-1.21)	(-2.67)	(-1.25)	(-1.16)	(-4.81)	(-1.06)	(-1.11)	(-6.25)
Germany x ST-LVG$_{t-1}$	-1.257**	-1.231**	-1.663	-1.243**	-0.942	-0.291	-0.745	-0.925	0.722*
	(-2.08)	(-1.99)	(-1.18)	(-2.06)	(-1.32)	(-0.38)	(-1.46)	(-1.47)	-2.85
Germany x Loans / Assets$_{t-1}$	-0.507	-0.937	0.755	-0.595	-1.026	-5.441**	-0.146	-0.091	0.306
	(-0.46)	(-0.81)	-0.49	(-0.54)	(-0.87)	(-3.22)	(-0.14)	(-0.08)	-0.26
Index	1.322***	1.343***	1.199***	1.326***	1.364***	1.102***	1.320***	1.273***	1.583***
	-16.04	-15.6	-8.8	-16.15	-16.25	-6.43	-15.85	-14.29	-17.5
Constant	-0.001	0	0.003	0	0	0.004	-0.001	-0.001	0
	(-0.44)	(-0.03)	-0.44	(-0.35)	-0.34	-1.9	(-0.46)	(-0.53)	(-0.13)
Observations	39,925	34,148	5,777	39,925	34,234	5,691	39,925	35,310	4,615
R-squared	0.46	0.44	0.62	0.46	0.45	0.68	0.46	0.44	0.57

- Particularly large banks and banks with short-term funding are undertaking more carry trades.

Regulatory Capital Ratios

- Another motive to invest in government debt is regulatory capital arbitrage because of how banks' balance sheet exposure is treated under existing capital rules.
    - The Capital Requirement Directive (CRD) assigns a zero risk weight for *"exposures to Member States' central government [...] denominated and funded in the domestic currency of that central government"* (BIS (2011)).
    - Under the standardized approach, sovereign debt has zero risk weights. Even under the internal ratings based (IRB) approach there is a loophole ("IRB permanent partial use").

- Particularly banks with low Tier 1 capital ratios have an incentive to shift into high risk assets (risk-shifting motive)

- Banks with high risk weighted assets have an incentive to invest in assets with lower risk weights (regulatory capital arbitrage motive)
    - We use Tier 1 ratio and RWA Assets as proxies for capitalization

Table VII. Regulatory Capital Ratios

	Full (1)	Italy Non-GIPSI (2)	GIPSI (3)	Full (4)	Spain Non-GIPSI (5)	GIPSI (6)	Full (7)	Greece Non-GIPSI (8)	GIPSI (9)
$GIPSI_t$	-0.576	-0.513	-0.986	-0.849*	-0.811*	-1.646**	-0.260	-0.349**	0.123
	(-1.19)	(-1.06)	(-0.87)	(-1.72)	(-1.65)	(-3.52)	(-1.05)	(-2.01)	(0.08)
$GIPSI \times Log\text{-}Assets_{t-1}$	0.073***	0.065**	0.079	0.081***	0.081***	0.180***	0.014	0.022***	-0.011
	(3.05)	(2.57)	(0.65)	(4.06)	(4.10)	(9.14)	(1.47)	(3.51)	(-0.08)
$GIPSI_t \times Tier\ 1_{t-1}$	-0.053***	-0.057***	0.117	-0.038	-0.035	-0.104*	0.001	-0.001	0.027
	(-3.47)	(-3.48)	(1.34)	(-1.55)	(-1.35)	(-2.61)	(0.15)	(-0.11)	(1.46)
$GIPSI_t \times RWA\,/\,Assets_{t-1}$	0.726***	0.776***	0.270	0.870***	0.934***	1.525**	0.201	0.109	0.353
	(3.02)	(3.02)	(0.42)	(4.27)	(4.61)	(3.21)	(1.44)	(1.28)	(1.19)
$GIPSI_t \times ST\text{-}LVG_{t-1}$	0.917***	1.073***	-1.353	0.730**	0.475	-0.142	0.197*	0.290***	-0.565
	(2.84)	(2.98)	(-1.51)	(2.15)	(1.23)	(-0.29)	(1.74)	(3.16)	(-1.28)
$Germany_t$	0.150	0.078	7.306	0.139	0.392	1.598	0.391	0.624	1.453
	(0.09)	(0.04)	(1.92)	(0.08)	(0.22)	(1.21)	(0.25)	(0.31)	(0.38)
$Germany \times Log\text{-}Assets_{t-1}$	-0.129*	-0.129	-0.545*	-0.132*	-0.141*	-0.414***	-0.123*	-0.141	-0.418
	(-1.68)	(-1.59)	(-2.45)	(-1.73)	(-1.80)	(-5.04)	(-1.70)	(-1.52)	(-0.88)
$Germany \times Tier\ 1_{t-1}$	-0.053	-0.037	-0.194	-0.047	-0.058	0.228**	-0.095**	-0.089*	-0.132
	(-1.10)	(-0.73)	(-1.94)	(-1.03)	(-1.28)	(3.44)	(-2.19)	(-1.71)	(-1.91)
$Germany_t \times RWA\,/\,Assets_{t-1}$	-0.528	-0.778	-1.511	-0.598	-1.101	-0.932	-0.441	-0.427	2.673
	(-0.53)	(-0.78)	(-0.79)	(-0.61)	(-1.08)	(-1.81)	(-0.48)	(-0.39)	(1.73)
$Germany \times ST\text{-}LVG_{t-1}$	-1.249**	-1.277**	-1.119	-1.271**	-0.884	-0.496	-0.629	-0.772	0.025
	(-2.06)	(-2.03)	(-0.76)	(-2.10)	(-1.15)	(-0.98)	(-1.24)	(-1.32)	(0.08)
Index	1.321***	1.342***	1.204***	1.326***	1.364***	1.097***	1.322***	1.276***	1.586***
	(15.90)	(15.44)	(8.94)	(16.03)	(16.13)	(6.37)	(15.77)	(14.35)	(18.76)
Constant	-0.002	-0.002	-0.017**	-0.002	-0.000	0.001	-0.003	-0.005***	-0.013
	(-1.08)	(-0.77)	(-2.82)	(-0.55)	(-0.12)	(0.70)	(-1.02)	(-2.78)	(-1.30)
Observations	39,711	33,934	5,777	39,711	34,020	5,691	39,711	35,310	4,401
R-squared	0.46	0.44	0.63	0.46	0.45	0.68	0.46	0.44	0.58

- We measure the effect individually and jointly, including ST-LVG as proxy for bank funding risk as well as size and interaction terms with size.

Risk-shifting and Regulatory Capital Arbitrage

- We find that banks with higher Tier1 capital ratios have lower exposure to Italian sovereign debt.
  - Tier1 capital increases if banks have higher RWA or if they decide to hold more economic capital. For a given amount of RWA, the negative coefficient implies higher risk-shifting incentives.

- Moreover, the positive coefficient on RWA / Assets (unlike the sign on Tier1) suggests that there is a regulatory arbitrage motive.
  - Only including one of these variables might result in biased estimates of the coefficients due to confounding effects.
  - Including both variables in the same model shows that the coefficient of Tier1 is even more negative (not reported). This result suggests that the discretionary part of Tier1 capital is more strongly related to the risk-shifting motive. In other words, not controlling for RWA understates the risk-shifting effect.

- The effects on Greek government bond holdings are (not surprisingly) somewhat muted.

Predicing Capital Raisings & ECB Dependence with Carry Trades

- As the crisis unfolded, GIPSI yields continued to rise while market value of banks dropped substantially

- Do banks with high exposures to carry trades need to increase their capital more than other banks (86% of sample banks have raised capital during this period)?

- We collect all common and preferred stock issuances of our sample banks over the January 2007 to February 2012 period on a quarterly basis.
  - Log-Capital is the natural logarithm of the amount of common and preferred capital raised.
  - ECB/Assets is funding obtained from the ECB relative to total assets.

- We use quarterly regressions for each bank and calculate the predicted return based on the estimated factor loadings and the constant term. The predicted return can be interpreted as the part of the returns that is induced by carry trades

Table IX. Capital Raisings and ECB Funding

	(1) Log-Capital	(2) ECB /Assets	(3) Log-Capital	(4) ECB /Assets	(5) Log-Capital	(6) ECB /Assets	(7) Log-Capital	(8) ECB /Assets
Realized Return$_{t-1}$	-2.036***	-0.001			-2.284***	0.011	-2.232***	0.031
	(-3.60)	(-0.02)			(-3.92)	(0.19)	(-3.70)	(0.50)
Predicted Return$_{t-1}$			-1.217**	-0.047				
			(-2.57)	(-0.95)				
$\beta_{Greece,t-1}$					0.881***	0.021		
					(2.73)	(1.12)		
$\beta_{Italy,t-1}$							0.169	0.029*
							(1.11)	(1.82)
$\beta_{Germany,t-1}$					0.023	-0.023***	-0.307**	-0.024***
					(0.14)	(-2.89)	(-2.07)	(-2.97)
Log-Assets$_{t-1}$	0.243***	-0.022***	0.202**	-0.022***	0.182**	-0.030***	0.155	-0.031***
	-3.01	(-3.49)	(2.21)	(-3.46)	(2.10)	(-4.28)	(1.64)	(-4.38)
Constant	-1.622*	0.338***	-1.086	0.326***	-1.051	0.374***	-1.379	0.382***
	(-1.72)	(4.02)	(-0.98)	(3.83)	(-1.03)	(4.07)	(-1.22)	(4.25)
Observations	750	80	699	76	699	76	699	76
R-squared	0.02	0.18	0.01	0.18	0.06	0.28	0.04	0.31

- Banks with lower realized returns as well as larger banks need to raise capital in the subsequent quarter and they need to raise more capital.
  - It is not the exposure in and off itself but the impairments and capital loss incurred that consequently prompt banks to raise capital.
- Banks that are heavily exposed to short-term wholesale markets are more reliant on ECB funding as well

The "Greatest" Carry Trade Ever?

Role of ECB in Funding Carry Trades

- In the "original" 1-year Long Term Refinancing Operations (LTRO) in 2009, the ECB lent about EUR 614 billion to European banks at an interest rate of 1 percent.

- *"The original LTROs, for instance, allowed some banks to go on a buying spree – using inexpensive ECB funds to snap up higher-yielding assets in a classic "carry trade". Unfortunately many of those investments appear to have taken the form of government debt from the region's weaker nations, strengthening the link between troubled sovereigns and banks which Europe is trying to desperately break."* (Tracy Alloway, FT, October 2011).

- Moreover, *"the banks pretty much used the last opportunity of getting cheap money to invest in sovereign debt they thought was even cheaper"* (Gary Jenkins, Head of Fixed Income at Evolution Securities).

Figure 4. Time Series of Stock and Bond Return Correlations

This graphic shows the 30-day rolling correlations between (1) stock returns and 10-year Italian bond returns and (2) stock returns and 10-year German bond returns for all European banks included in the sample. The red lines indicate the four 1-year LTROs of the ECB on June 6, 2009, September 30, 2009, December 16, 2009 and October 27, 2011 as well as the first 3-year LTRO on December 20, 2012.
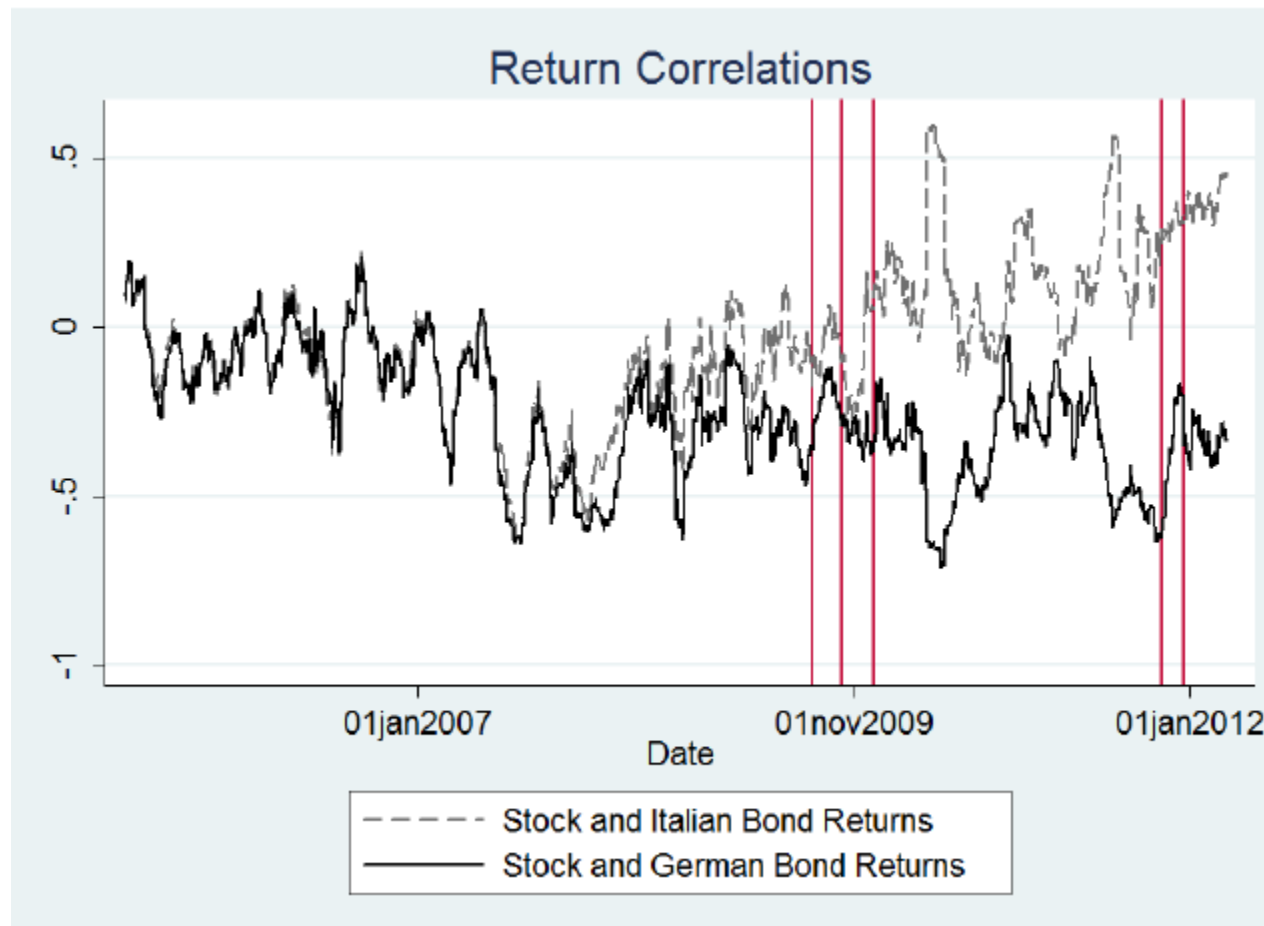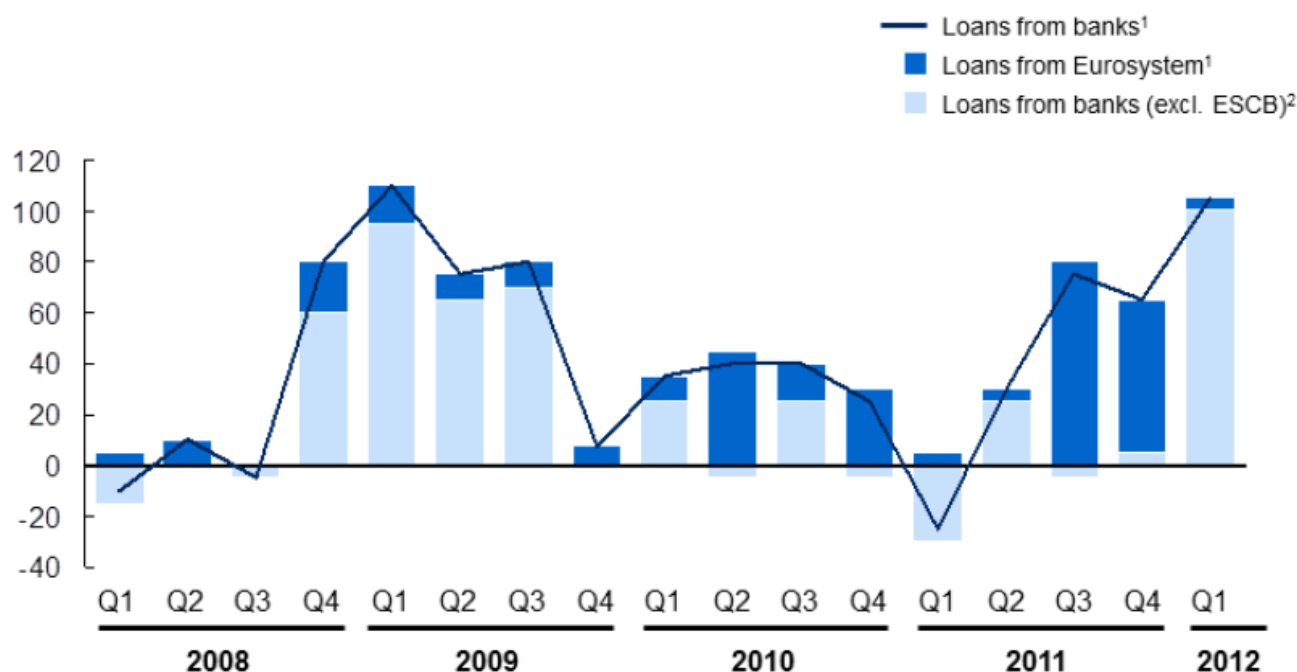
Figure 5. Loans and Sovereign Bond Flows into Public Sector

- Loans from banks[1]
- Loans from Eurosystem[1]
- Loans from banks (excl. ESCB)[2]

1 ECB
2 Bundesbank calculation based on ECB data

SOURCE: ECB, Deutsche Bundesbank

- Over EUR 280 billion invested by banks after the third 1-year LTRO. While banks have been net seller of sovereign debt in Q1 and Q3 2011, they purchased again in Q4 2011 after the fourth 1-year LTRO. About EUR 130 billion of flows in Q3 and Q4 2011 were coming from the Eurosystem.

Table X. ECB LTRO Operations (NON-Italian Banks)

Dependent Variable:	(1)	(2)	(3)	(4) Stock Returns	(5)	(6)	(7)	(8)
	July 2011	Aug 2011	Sept 2011	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012
$Italy_t$	-1.206	0.238	-2.295	0.148	-1.010	-0.597	0.573	-4.810**
	(-1.43)	(0.53)	(-0.82)	(0.03)	(-1.05)	(-0.62)	(0.45)	(-2.32)
$Italy_t$ x $Log\text{-}Assets_{t-1}$	0.072	0.046**	0.096	0.043	0.046	0.010	0.057	0.273**
	(1.67)	(2.35)	(0.66)	(0.19)	(1.11)	(0.21)	(0.79)	(2.60)
$Italy_t$ x $Tier\ 1_{t-1}$	0.099*	-0.091**	-0.011	-0.088	-0.030	0.064	-0.098***	-0.076**
	(1.90)	(-2.53)	(-0.15)	(-0.36)	(-0.71)	(1.58)	(-5.58)	(-2.44)
$Italy_t$ x $RWA\ /\ Assets_{t-1}$	-0.277	0.837***	2.449*	0.798	0.869*	0.210	0.319	1.492
	(-0.53)	(3.84)	(1.89)	(0.34)	(1.83)	(0.42)	(0.45)	(1.49)
$Italy_t$ x $ST\text{-}LVG_{t-1}$	-0.732	0.322	1.389	-0.427	1.244*	-0.475	0.661	5.258***
	(-1.20)	(0.99)	(1.18)	(-0.12)	(1.95)	(-0.77)	(0.98)	(3.46)
$Germany_t$	0.189	0.622	0.682	-1.695	-5.419	0.057	-2.117	-3.570
	(0.08)	(0.13)	(0.15)	(-0.57)	(-1.56)	(0.02)	(-0.70)	(-0.63)
$Germany_t$ x $Log\text{-}Assets_{t-1}$	-0.140	-0.103	-0.209	-0.033	0.076	-0.126	0.093	0.039
	(-1.18)	(-0.51)	(-0.88)	(-0.24)	(0.46)	(-0.99)	(0.61)	(0.12)
$Germany_t$ x $Tier\ 1_{t-1}$	0.053	-0.097	-0.060	0.110	0.017	0.133	-0.365***	-0.114**
	(0.36)	(-0.76)	(-0.54)	(0.97)	(0.11)	(0.98)	(-5.20)	(-2.08)
$Germany_t$ x $RWA\ /\ Assets_{t-1}$	-2.369*	-0.294	-0.348	-1.691	0.840	-2.946	2.280	-2.118
	(-1.97)	(-0.13)	(-0.15)	(-0.99)	(0.40)	(-1.56)	(1.51)	(-0.85)
$Germany_t$ x $ST\text{-}LVG_{t-1}$	-2.654	-0.098	0.124	-3.038	2.976	-4.235**	3.319*	4.495
	(-1.17)	(-0.04)	(0.05)	(-1.57)	(1.01)	(-2.16)	(1.80)	(1.59)
Stock Index	1.513***	1.244***	1.263***	2.018***	1.460***	1.234***	1.739***	2.445***
	(3.88)	(12.34)	(14.00)	(7.45)	(10.75)	(7.22)	(8.79)	(6.02)
Observations	585	620	610	548	561	541	512	252
R-squared	0.36	0.46	0.60	0.49	0.43	0.35	0.60	0.65

- After the fourth 1-year LTRO, the coefficient of Italian bond returns even tripled from November 2011 to February 2012. Before the LTROs in Q3 and Q4 2011, interbank market froze and investors flew into German government bonds causing bond prices to rise.

The "Greatest" Carry Trade Ever?

Figure 6. Lending to Non-Financial Corporates vs. Government Securities Holding by Europan Banks
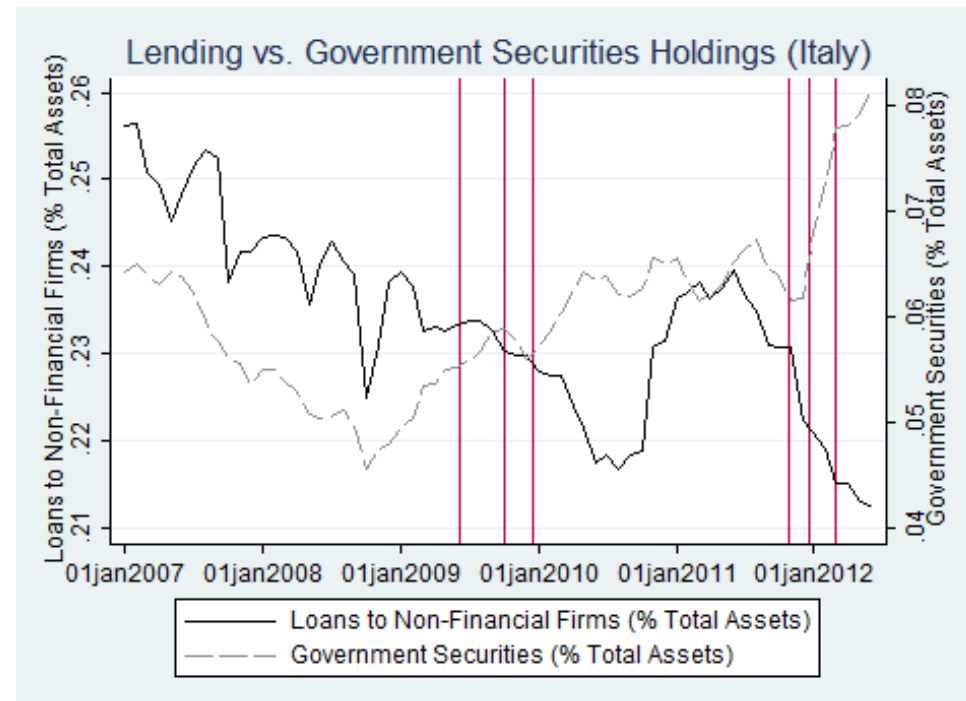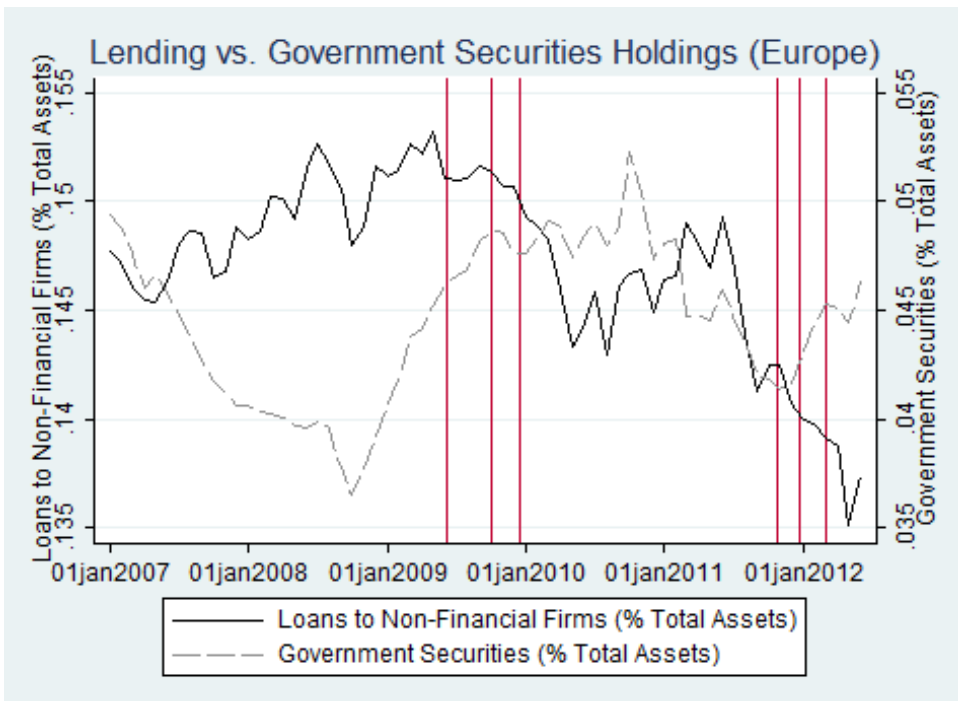
- The red lines indicate the four 1-year LTROs of the ECB on June 6, 2009, September 30, 2009, December 16, 2009 and October 27, 2011 as well as the two 3-year LTRO on December 20, 2011 and March 1, 2012.

Table XI. Do Investments in Government Bonds Crowd Out Lending? Panel A: ECB country level data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Loans / Government Securities				Government Securities (% Total Assets)			Loans (% Total Assets)		
			Not Italy and Spain	Only Italy and Spain		Not Italy and Spain	Only Italy and Spain		Not Italy and Spain	Only Italy and Spain
2009 LTROs	-0.8080***	-0.8077***	-0.7378***	-0.6911**	0.0047***	0.0049***	0.0041**	-0.0006	-0.0005	0.0008
	(-5.39)	(-5.39)	(-4.22)	(-2.16)	(5.85)	(5.44)	(2.58)	(-0.48)	(-0.32)	(0.42)
Oct 2011 / Dec 2011 LTRO	-0.0720	-0.0856	-0.0793	0.2006	-0.0004	-0.0012	-0.0009	-0.0028	-0.0027	-0.0039
	(-0.22)	(-0.26)	(-0.20)	(0.47)	(-0.22)	(-0.60)	(-0.33)	(-1.24)	(-1.32)	(-0.71)
March 2012 LTRO	-0.2457	-0.2800	-0.1687	-0.3936	-0.0000	-0.0038	0.0105***	-0.0043	-0.0032	-0.0125**
	(-0.52)	(-0.59)	(-0.30)	(-0.73)	(-0.01)	(-1.28)	(4.10)	(-1.23)	(-1.00)	(-2.11)
Log-TA	-8.4690***	-8.3727***	-9.1027***	4.8975	0.0145***	0.0133**	-0.0454**	-0.0440***	-0.0353***	-0.0072
	(-7.44)	(-7.29)	(-7.06)	(1.27)	(2.67)	(2.19)	(-2.27)	(-5.80)	(-4.55)	(-0.20)
Log-Banks	-0.6535***	-0.6217***	-0.7434***	-8.9936	-0.0007	-0.0003	-0.0176	-0.0140***	-0.0150***	-0.2520***
	(-4.06)	(-3.81)	(-4.44)	(-0.82)	(-0.61)	(-0.23)	(-0.33)	(-8.06)	(-8.70)	(-2.77)
Deposits / Assets	3.1245***	3.1286***	3.0145***	3.8664***	-0.0063**	-0.0029	-0.0228***	0.0210***	0.0171***	0.0304***
	(6.05)	(6.05)	(5.25)	(3.10)	(-2.16)	(-0.95)	(-4.48)	(7.41)	(7.16)	(2.87)
Repos / Assets	-29.1993*	-28.7485*	-55.8495**	38.6281	0.0137	-0.0126	-0.1302	0.5372***	0.1089	0.2958
	(-1.96)	(-1.92)	(-2.43)	(1.61)	(0.12)	(-0.06)	(-1.10)	(3.90)	(0.72)	(1.30)
Capital (Yes / No)		-0.1191			0.0021**			-0.0002		
		(-0.77)			(2.46)			(-0.18)		
ΔEuropean Economic Sentiment	-0.0378***	-0.0383***	-0.0405***	-0.0141**	0.0002***	0.0002***	0.0001	-0.0001***	-0.0001***	-0.0001**
	(-6.72)	(-6.79)	(-6.10)	(-2.26)	(9.93)	(9.47)	(1.57)	(-4.05)	(-3.68)	(-2.13)
Constant	66.8017***	65.9581***	71.6824***	23.1532	-0.0681*	-0.0636	0.5527**	0.5392***	0.4854***	1.9810***
	(8.16)	(7.96)	(7.77)	(0.42)	(-1.65)	(-1.38)	(2.00)	(9.25)	(8.15)	(4.43)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	725	725	593	132	725	593	132	725	593	132
R-squared	0.72	0.72	0.71	0.78	0.84	0.85	0.84	0.98	0.97	0.89

- Negative sign of the coefficients in models (1) – (4) indicates that banks use the ECB liquidity to purchase sovereign debt rather than increase lending to firms.
- Banks, on average, do not increase lending after increasing capital.
- Particularly Italian and Spanish banks increased sovereign debt purchases after recent 3-year LTRO.

Table XI. Do Investments in Government Bonds Crowd Out Lending? Panel B: Bank level analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Loans / Government Securities				Government Securities (% Total Assets)			Loans (% Total Assets)		
			Not Italy and Spain	Only Italy and Spain		Not Italy and Spain	Only Italy and Spain		Not Italy and Spain	Only Italy and Spain
2009 LTROs	-0.685**	-0.623**	-0.811***	-0.182	0.013***	0.015***	0.005	-0.002	-0.002	-0.005
	(-2.47)	(-2.24)	(-2.80)	(-0.26)	(3.86)	(3.92)	(0.76)	(-0.96)	(-0.64)	(-0.89)
Dec'11 / March'12 LTROs	0.305	0.325	0.282	-2.382*	-0.006	-0.007	0.019*	-0.004	-0.001	-0.013**
	(0.62)	(0.65)	(0.72)	(-1.97)	(-0.81)	(-0.89)	(1.88)	(-0.67)	(-0.15)	(-2.01)
Log-TA	-0.934	-0.979	0.404	-12.659**	0.014	0.007	0.076**	-0.053***	-0.041**	-0.137***
	(-0.85)	(-0.89)	(0.49)	(-2.27)	(0.89)	(0.40)	(2.05)	(-2.81)	(-2.06)	(-3.02)
Capital Raising		-0.432			-0.002			-0.000		
		(-1.53)			(-0.48)			(-0.10)		
Constant	17.226	17.779	0.418	162.037**	-0.025	0.081	-0.839*	1.218***	1.046***	2.352***
	(1.32)	(1.36)	(0.04)	(2.41)	(-0.13)	(0.43)	(-1.86)	(5.51)	(4.50)	(4.31)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	362	362	291	71	373	292	81	559	439	120
R-squared	0.73	0.73	0.72	0.71	0.90	0.89	0.84	0.98	0.97	0.94

- Note that we cannot distinguish between the 2011 and 2012 LTROs because of the closeness of the ECB interventions which results in overlapping quarters. The results show similar patterns as observed using monthly country level data.

- Overall, our results suggest that the success of the ECB as to channel liquidity into the real sector was rather limited. Instead, banks used the liquidity to increase their portfolios of sovereign debt crowding-out lending to the real sector.

The "Greatest" Carry Trade Ever?

Conclusion

- During the past 2 years, increasing economic imbalances between core Europe and the periphery have caused a surge in the yield spread of peripheral countries (such as Greece, Italy, Ireland, Portugal and Spain) and a flight into German bunds.

- In this paper, we argue that European banks have placed bets on the diverging economic development within the euro area expecting (hoping!) yield spreads between, for example, Italy and Germany or Spain and Germany to converge.

- These bets or "carry trades" were designed as investments in GIPSI government bonds financed with short-term debt. As the sovereign debt crisis deepened and the situation materialized as it is, European banks lost a substantial portion of their market value.

Conclusion (cont'd)

- We consider various motives for banks to participate in carry-trades such as implicit bailout guarantees, risk-shifting, regulatory capital arbitrage, and cheap ECB financing that may have made these trades attractive for European banks.
  - We find that large banks as well as banks with more short-term debt relative to total debt, low Tier-1 ratios and high risk-weighted assets have larger carry trade exposures.

- Banks used ECB liquidity to increase their portfolios of sovereign debt rather than lending to the real sector.

- Our paper has important policy implications:
  - It speaks to the treatment of sovereign debt in the calculation of regulatory capital that a bank is required to hold. Zero risk weights imposed by the regulator increase the benefits of carry trades vis-à-vis private sector lending.
  - More broadly, it questions the role of banks in financing government debt.

The "Greatest" Carry Trade Ever?